CLAIMS

1.   A system for controlling color reproduction of input color image data representing one or more pages comprising:

a network having nodes, each one of said nodes comprising at least one rendering device;

means for distributing said input color image data from said one of said nodes to other said nodes;

means for producing a data structure in said network, said data structure comprising components shared by the nodes, and other components present only at each said node;

means for providing color calibration data at each said node characterizing output colors of the rendering device of the node;

means for producing at each said node, responsive to the color calibration data of the rendering device of the node, information for transforming the input color image data into output color image data at the rendering device of the node;

means for storing said information in said data structure in different ones of said shared and said other components;

means for transforming at each said node said input color image data into output color image data for the rendering device of the node responsive to said information in said data structure; and

means for rendering at the rendering device of each said node a color reproduction of said pages responsive to said output color image data, wherein colors displayed in said reproduction at the rendering device of each said node appear substantially the same within output colors attainable by the rendering devices.

2.   The system according to Claim 1 further comprising:

means for verifying at each said node that said information for the rendering device of the node properly transformed the input color image data into the output color image data; and

means for revising said information stored in the data structure at the node responsive to results of said verifying means.

3. The system according to Claim 2 wherein each said node further comprises a computer, coupled to the rendering device of the node, which controls said rendering device and communicates with other said nodes in the network, wherein said producing means, said transforming means, said rendering means, said verifying means and said revising means are operative by said computer at each said node.

4. The system according to Claim 1 further comprising:

means for selecting color preferences for color reproduction of said pages at said nodes; and

means for storing said color preferences in said data structure; and

said producing means further comprises means for producing at each said node, responsive to said color calibration data of the rendering device and said color preferences, information for transforming the input color image data into output color image data at the rendering device of the node.

5. The system according to Claim 4 wherein said color preferences define one of said shared components of said data structure, and said calibration data define one of said other components of said data structure.

6. The system according to Claim 1 wherein each said rendering device comprises one of a printing press and a proofer device.

7. The system according to Claim 1 wherein the rendering device of at least one of said nodes is a high volume printing press, and said rendering means at said one of said nodes further comprises means for controlling said high volume printing press to render said color reproduction of said pages responsive to said output color image data.

8. The system according to Claim 1 wherein said transforming means further comprising means for transforming at one of said nodes said input color image data into

output color image data to represent the rendering device at another said node responsive to said information in said data structure; and

said rendering means further comprises means for rendering at said rendering device of said one of said nodes a color reproduction responsive to output color image data representing the reproduction at the rendering device at said another node.

9. The system according to Claim 1 further comprising means for storing information in said data structure defining the network of nodes, the rendering devices of the nodes, and data flow between said nodes.

10. The system according to Claim 1 wherein said means for providing color calibration data at each said node further comprises:

means for rendering calibration forms at the rendering device of the node defining the entire gamut of output colors attainable by the rendering devices in the network; and

means for measuring said calibration forms with a color measuring instrument to provide calibration data characterizing the rendering device of the node in standard color units.

11. The system according to Claim 10 wherein said color measuring instrument comprises at least one sensor adapted to receive signals from said calibration forms.

12. The system according to Claim 1 wherein said producing means at each said node further comprising:

means for building a forward model responsive to said color calibration data of the rendering device of the node defining the relationship of input colors of said input color image data to output colors attainable by the rendering devices in the network;

means for preparing a forward model table based on said forward model of the input colors to combinations of the output colors attainable by the rendering devices in the network;

means for preparing gamut descriptor data defining the output colors of the rendering device of the node;

means for inverting the forward model table to provide a prototype transformation table defining the output colors of the rendering device of the node based on combinations of the input colors;

means for revising the prototype transformation table to include those output colors in said gamut descriptor data;

means for converting the output colors of the prototype transformation table responsive to first color preference data;

means for building an output color transform table responsive to second color preference data; and

means for combining the output color transform table and the converted prototype transformation table to provide a rendering table defining the output colors of the rendering device of the node based on combinations of the input colors, whereby said information for transforming the input color image data into output color image data for the rendering device of the node comprises at least said rendering table.

13. The system according to Claim 12 wherein said information for the rendering device of one of said nodes comprises said color calibration data, said forward model, said forward model table, said gamut descriptor data, said prototype transformation table, said converted prototype transformation table, and said output color transform table.

14. The system according to Claim 12 wherein said second color preference data comprises gamut configuration data for the rendering device of the node defining a relationship between output colors in the gamut descriptor data and output colors in the prototype transformation table absent in the gamut descriptor data, and a neutral output color function.

15.   The system according to Claim 12 wherein said first color preference data comprises black color data which defines appearance of a black one of said output colors and a relationship of other said output colors to said black output color.

16.   The system according to Claim 15 wherein said black color data comprises a percentage of UCR, a maximum black color; and GCR data.

17.   The system according to Claim 1 wherein each said node further comprises a database, and said system further comprise means for storing a summary of said color calibration data for said rendering device in said database at said node associated with the rendering device.

18.   The system according to Claim 12 further comprising at one of said nodes:
        means for generating a filter table responsive to the converted protype transformation table of the rendering table of the mode having indicators for possible output colors for combination of the input colors;
        means for storing said filter table in said data structure; and
        means for overlaying a graphical representation of said filter table onto said reproduction rendered at said rendering device of the node.

19.   The system according to Claim 12 further comprising at one of said nodes:
        means for generating a filter table responsive to the converted prototype transformation table of the rendering device of the node having indicators for possible output colors for combination of the input colors;
        means for storing said filter table in said data structure;
        applying said filter table to the rendering table of the rendering device of another said node to provide a filtered rendering table;
        means for transforming said input color image data into filtered output color image data for the rendering device of said another said node responsive to said filtered rendering table; and

means for rendering at the rendering device of said another said node a color reproduction of said pages responsive to said filtered output color image data.

20.   The system according to Claim 1 wherein the rendering device of one of said nodes has more than four output colors.

21.   The system according to Claim 1 wherein the rendering device of one of said nodes has one of three and four output colors.

22.   The system according to Claim 1 wherein said verifying means at each said node further comprising:

means for rendering verification forms by the rendering device of the node;

means for measuring colors of the verification forms; and

means for comparing statistically the measured colors with reference data for said verification forms to provide color error data at the node; and

said revising means further comprises means for revising said information of said data structure at the node responsive to said color error data.

23.   The system according to Claim 1 wherein said information producing means further comprises means for producing at each said mode said information utilizing one or more neural networks.

24.   The system according to Claim 1 further comprising:

means for providing linearization information characterizing correction of non-linearity in rendering output colors for the rendering device of the mode; and

means for revising said information for transforming said input color image data into output color image data responsive to said linearization information.

25.   The system according to Claim 1 further comprising:

means for revising said information for transforming said input color image data into output color image data to provide rendering of greater than four output colors.

26.   The system according to Claim 1 further comprising means for conferencing between said modes to allow users at said nodes to negotiate characteristics of colors displayed in said reproduction of said pages at said nodes.

27.   A method for controlling color reproduction at a plurality of nodes in a network, each said node having at least one rendering device, said method comprising the steps of:

providing a data structure in said network, said data structure comprising components shared by the nodes, and other components present only at each said node;

providing at each said node common input color image data representing one or more pages;

providing color calibration data at each said node characterizing output colors of the rendering device of the node;

producing at each said node, responsive to the color calibration data of the rendering device of the node, information for transforming the input color image data into output color image data at the rendering device of the node;

storing said information in said data structure in different ones of said shared and said other components;

transforming at each said node said input color image data into output color image data for the rendering device of the node responsive to said information in said data structure; and

rendering at the rendering device of each said node a color reproduction of said pages responsive to said output color image data, wherein colors displayed in said reproduction at the rendering device of each said node appear substantially the same within output colors attainable by the rendering devices.

28.   The method according to Claim 27 further comprising the steps of:

verifying at each said node that said information for the rendering device of the node properly transformed the input color image data into the output color image data; and

revising said information stored in the data structure at the node responsive to results of said verifying step.

29.   The method according to Claim 27 further comprising the steps of selecting color preferences for color reproduction of said pages at said nodes, and storing said color preferences in said data structure, and said producing step further comprises producing at each said node, responsive to said color calibration data of the rendering device and said color preferences, information for transforming the input color image data into output color image data at the rendering device of the node.

30.   The method according to Claim 29 wherein said color preferences define one of said shared components of said data structure, and said calibration data define one of said other components of said data structure.

31.   The method according to Claim 27 further comprising the step of:

proofing said rendered color reproduction at least one said node in the network.

32.   The method according to Claim 27 wherein each said rendering device comprises one of a printing press and a proofer device.

33.   The method according to Claim 27 wherein the rendering device of at least one of said nodes is a high volume printing press, and said rendering step at said one of said nodes further comprises controlling said high volume printing press to render said color reproduction of said pages responsive to said output color image data.

34.   The method according to Claim 27 wherein said transforming step further comprising the step of transforming at one of said nodes said input color image data into

output color image data to represent the rendering device at another said node responsive to said information in said data structure; and

said rendering step further comprises the step of rendering at said rendering device of said one of said nodes a color reproduction responsive to output color image data representing the reproduction at the rendering device at said another node.

35.   The method according to Claim 27 further comprising the step of storing information in said data structure defining the network of nodes, the rendering devices of the nodes, and data flow between said nodes.

36.   The method according to Claim 27 wherein said step of providing color calibration data at each said node comprises the steps of:

rendering calibration forms at the rendering device of the node defining the entire gamut of output colors attainable by the rendering devices in the network; and

measuring said calibration forms with a color measuring instrument to provide calibration data characterizing the rendering device of the node in standard color units.

37.   The method according to Claim 27 wherein said producing step at each said node further comprising the steps of:

building a forward model responsive to said color calibration data of the rendering device of the node defining the relationship of input colors of said input color image data to output colors attainable by the rendering devices in the network;

preparing a forward model table based on said forward model of the input colors to combinations of the output colors attainable by the rendering devices in the network;

preparing gamut descriptor data defining the output colors of the rendering device of the node;

inverting the forward model table to provide a prototype transformation table defining the output colors of the rendering device of the node based on combinations of the input colors;

revising the prototype transformation table to include those output colors in said gamut descriptor data;

converting the output colors of the prototype transformation table responsive to first color preference data;

building an output color transform table responsive to second color preference data; and

combining the output color transform table and the converted prototype transformation table to provide a rendering table defining the output colors of the rendering device of the node based on combinations of the input colors, whereby said information for transforming the input color image data into output color image data for the rendering device of the node comprises at least said rendering table.

38. The method according to Claim 37 wherein said information for the rendering device of one of said nodes comprises said color calibration data, said forward model, said forward model table, said gamut descriptor data, said prototype transformation table, said converted prototype transformation table, and said output color transform table.

39. The method according to Claim 37 wherein said second color preference data comprises gamut configuration data for the rendering device of the node defining a relationship between output colors in the gamut descriptor data and output colors in the prototype transformation table absent in the gamut descriptor data, and a neutral output color function.

40. The method according to Claim 37 wherein said first color preference data comprises black color data which defines appearance of a black one of said output colors and a relationship of other said output colors to said black output color.

41. The method according to Claim 37 wherein said black color data comprises a percentage of UCR, a maximum black color; and GCR data.

42.   The method according to Claim 27 further comprising storing a summary of said color calibration data for said rendering device in a database at said node associated with the rendering device.

43.   The method according to Claim 37 further comprising at one of said nodes:

generating a filter table responsive to the converted prototype transformation table of the rendering table of the node having indicators for possible output colors for combinations of the input colors;

storing said filter table in said data structure; and

overlaying a graphical representation of said filter table onto said reproduction rendered at said rendering devices of the node.

44.   The method according to Claim 37 further comprising at one of said nodes the steps of:

generating a filter table responsive to the converted prototype transformation table of the rendering device of the node having indicators for possible output colors for combination of the input colors;

storing said filter table in said data structure;

applying said filter table to the rendering table of the rendering device of another said node to provide a filtered rendering table;

transforming said input color image data into filtered output color image data for the rendering device of said another said node responsive to said filtered rendering table; and

rendering at the rendering device of said another said node a color reproduction of said pages responsive to said filtered output color image data.

45.   The method according to Claim 27 wherein the rendering device of one of said nodes has more than four output colors.

46.   The method according to Claim 27 wherein the rendering device of one of said nodes has one of three and four output colors.

47.   The method according to Claim 27 wherein said step of verifying at each said node further comprising the steps of:

rendering verification forms by the rendering device of the node;

measuring colors of the verification forms; and

comparing statistically the measured colors with reference data for said verification forms to provide color error data at the node; and

said revising step further comprises revising said information of said data structure at the node responsive to said color error data.

48.   The method according to Claim 27 further comprising:

providing linearization information characterizing correction of non-linearity in rendering output colors for the rendering device of the node; and

revising said information for transforming said input color image data into output color image data responsive to said linearization function.

49.   The method according to Claim 27 further comprising:

revising said information for transforming said input color image data into output color image data to provide rendering of greater than four output colors.

50.   The method according to Claim 28 further comprising conferencing between said nodes to allow users at said nodes to negotiate characteristics of color displayed in said reproduction of said pages at said nodes.

51.   A color reproduction apparatus for rendering a page with color uniform with a remote device rendering the same said page comprising:

means for communicating with said remote rendering device;

means for receiving input color image data corresponding to said page via said communicating means;

means for producing a data structure with components shared by said apparatus and said remote device and components local to said apparatus, said data structure having information for transforming the input color image data into output color image data which will provide uniform appearance of color of said page at both said apparatus and said remote device, said communicating means being operative by said producing means to provide said shared data structure;

means for transforming said input color image data into output color image data responsive to said information in said data structure;

means for rendering said page at said apparatus responsive to said output color image data;

means for verifying that the information in said data structure properly transformed said input color image data into said output color image data; and

means for revising the information in the data structure responsive to said verifying means; and

means for producing color calibration data characterizing output colors of the apparatus which is operative by said means for producing a data structure and said means for verifying.

52.   A method of virtual proofing at a plurality of rendering devices configured into a network, each said rendering device having a calibration transform to render color images, said method comprising the steps of:

transferring color image data from one of said plurality of rendering devices to others of said rendering devices in said network;

calibrating color measure instruments associated with each said rendering device;

rendering a known color image at each said rendering device;

measuring the rendering image at each said rendering device with the color measuring instrument to provide color data;

comparing the measured color data with color data of the known color image to provide color-error data;

evaluating the color-error data responsive to tolerance levels to indicate when the calibration of each said rendering device is one of within said tolerance levels and outside said tolerance levels;

producing at one of said plurality of rendering devices when said calibration of the rendering device is outside said tolerance levels another calibration transform;

building a correction transform based upon said color-error data when said calibration of one of said rendering devices is within said tolerance levels;

revising the calibration transform of said rendering device with said correction transform; and

rendering said image data at each rendering device responsive to one of said revised calibration transform and said another calibration transform.

53.   A user interface for controlling color reproduction at multiple sites, which is implemented on a computer using object oriented components, comprising:

an abstract menu object comprising:

a command name object;

a method for drawing the command name object; and

means for selecting the abstract menu object; and

a submenu command object derived from the abstract menu object, and comprising means for executing the submenu command object; and

a menu command object derived from the abstract menu object, comprising:

a plurality of the submenu command objects;

means for selecting one of the submenu command objects; and

a menu bar object derived from the abstract menu object, comprising:

a plurality of the menu command objects; and

a select menu for selecting one of the menu command objects.

54.   The user interface according to Claim 53, further comprising:

an action command object derived from the submenu command object comprising:

means for selecting said action command object; and

means for carrying out the action command object for one of defining a network of said multiple sites, defining color transformation at one or more of said sites, and defining user preferences for color reproduction at one or more of said multiple sites.

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